Electronic structure of CMR compounds investigated by means of XES

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INTRODUCTION

In the last few years the manganese perovskites $La_{1-x}A_xMn_{1-y}TM_yO_3$ (A = Ca, Ba, Sr, TM = Co, Ni, Fe) have been subject to intense experimental and theoretical studies due to the colossal magnetoresistance effect (CMR) [1, 2, 3]. The mother compound $LaMnO_3$ is an A-type antiferromagnetic insulator with orthorhombic crystal structure. We present results of Resonant X-ray emission spectroscopy (RXES) of $LaMnO_3$ performed at at Beamline 8.0.1 equipped with SXF endstation.

Recently the CMR effect in a double perovskite system, Sr_2FeMoO_6, has been discovered [4]. This material shows a strong effect at low magnetic fields and a high ferromagnetic transition temperature ($T_c \approx 420$K) and a half metallic behaviour as predicted on the basis of band structure calculations. In contrast Sr_2FeWO_6 is an antiferromagnetic insulator [5]. Because of the different transport properties of these two materials, it is predicted that an alloy $Sr_2FeMo_xW_{1-x}O_6$ will show a metal-insulator transition (MIT) as a function of x. While in an earlier work the critical concentration was reported to be between $0.4 < x_c < 0.5$ [6], Ray *et. al.* found $x_c \approx 0.25$ [7]. The aim of this work is to investigate the influence of the predicted MIT to the partial density if states. Therefore we recorded RXES data at the L edge of Fe, the M edge of Mo, and the K edge of O of Sr_2FeMoO_6 and $Sr_2FeMo_xW_{1-x}O_6$, respectively.

RESULTS AND DISCUSSION

Sr_2FeMoO_6 and $Sr_2FeMo_{0.6}W_{0.4}O_6$

Figure 1 shows the Fe L-emission spectra taken at indicated excitation energies, for both samples.

We recognise that these spectra for both materials look very similar. One can investigate additionally to the NXES-peak a rather weak elastic peak. At $E_{exc} \approx 720$ eV

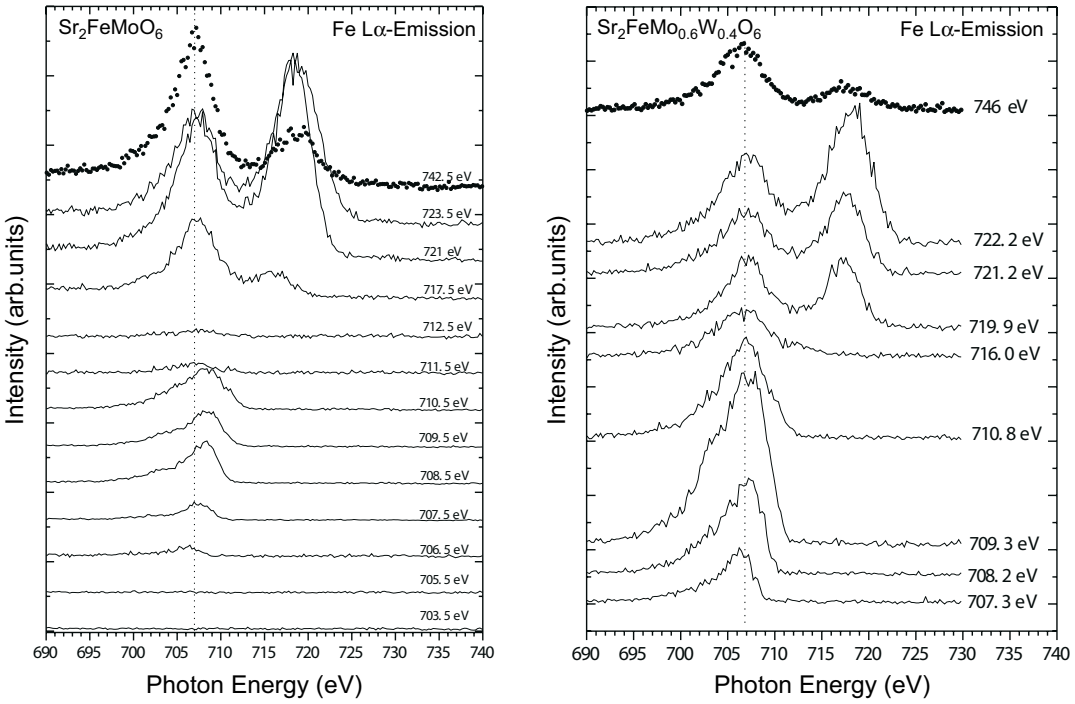

Figure 1: Fe Lα emission spectra of Sr_2FeMoO_6 and $Sr_2FeMo_{0.6}W_{0.4}O_6$

a strong resonance for both samples can be observed. At E_{exc} = 738 eV one observes an emission from the 3d level not only into the $2p_{3/2}$ level but also into the $2p_{1/2}$ level. The intensity ratio of both components is slightly below the expected value of 2. This indicates the presence of Coster-Kronig-transitions. The O Kα-emission spectra (not shown here) show for both materials only a weak energy dependence. The main emission features can be observed at 525.5 eV for both samples. This results are in good agreement with the relusts of Ray *et. al.* [7], the measurements of Fe L-emission of $Sr_2FeMo_{0.6}W_{0.4}O_6$ show no significant difference compared to the recorded spectra of Sr_2FeMoO_6, thus $Sr_2FeMo_{0.6}W_{0.4}O_6$ shows halfmetallic behaviour, although doped with 40 % tungsten on Mo lattice site.

$LaMnO_3$

In figure 2 we present Mn L-emission spectra of $LaMnO_3$. The Mn $L_{2,3}$ emission features are strongly dependent on the excitation energy. At E_{exc} = 642.7 eV a maximum in intensity of three emission peaks around 640 eV is observed. With increasing excitation energy, the intensity of the L_2 emission peaks drops to almost zero when the L_3 emission peak reaches a maximum of intensity around 650 eV. At higher excitation energy the normal x-ray emission takes place. These results are in in further evaluation in order to prepare further measurements on $La_{1-x}A_xMn_{1-y}TM_yO_3$ (A = Ca, Ba, Sr, TM = Co, Ni, Fe)-compounds. These measurements are necessary for a deeper understanding of hybridization in presence of different dopants in different concentrations.

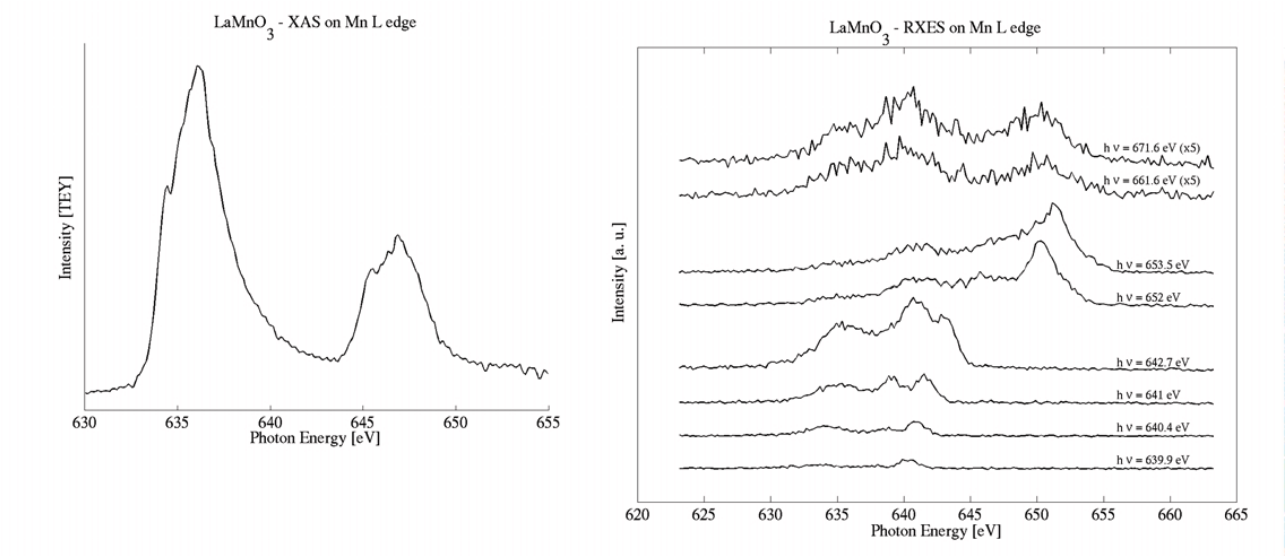

Figure 2: Mn L absorption and emission spectra of $LaMnO_3$

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